shall be determined from an average of five cylinders tested at each age. The cylinders shall be removed from the forms 24 hours after moulding and shall be stored in a moist closet or in damp sand until tested.

Sand failing to develop the above strengths may, at the option of the Engineer, be accepted for use, provided that the proportion of cement be increased by an amount sufficient to fulfil the strength test requirements.

It is believed that these specifications are adapted to the determination of a satisfactory sand aggregate for general concrete work. Whenever the conditions involved require the use of concrete having special density, toughness, or other physical properties, the fitness of a given sand should be determined by special test.

The specifications assume that provision is made for the proper proportioning of the cement content of the mix, in cases where sands failing to meet the strength requirements are used. It also assumes that proper provision is made for the limiting of the water content of the mix to that required to produce a saturated, sticky, semi-plastic mortar.

It will be noted that the time limits provided for in the specifications are nominally the same as those provided for in the testing of cement.

Conclusions

The description of methods used and of results obtained have been given sufficiently in detail to permit the reader to modify and correct the conclusions of the author, accordingly as his greater experience or better judgment dictates. However, from a careful consideration of the results obtained and of the phenomena observed, the following conclusions appear to be warranted:

1. The commonly practiced "visual examination" test of sand aggregate for concrete is generally unreliable, since it gives at best only a superficial knowledge of the cleanliness of a given sand. Its adaptation to the determination of grading could be of value to the observer only after long experience in the granulometric analysis of sands.

2. The generally accepted practice of proportioning a concrete mix by volume, as, for example, 1 part cement, 2 parts sand and 4 parts broken stone, is impracticable and unscientific, since it does not take into account the adaptability of the grading of a given sand to the production of a dense, strong, and reliable concrete. Proportioning by volume, as commonly used, gives no guarantee of the production of a concrete having a desired strength, hardness, or other physical properties.

3. The strength, toughness, and durability of the concrete to be secured from the use of a given sand can be determined only by an actual test of that sand in a properly prepared concrete.

4. In field operations incident to spading, slicing, or otherwise compacting the concrete, the movement of the water content of the mass is intensified, whenever the sand aggregate contains insufficient fine material to hold the cement in suspension by the formation of an adequate amount of sandy paste. The free movement of the water tends to produce an improper distribution of the cement.

5. The use of a quantity of water sufficient to produce a concrete, the mortar component of which is of a saturated, sticky, semi-plastic consistency, is for most practical purposes required, in order to facilitate economical and efficient placing. This quantity of water is ample for the development of the proper functions of the cement. An increase in the quantity of water used results in a proportionate decrease in the strength of the concrete. This decrease is in no sense a function of the proportions of the mix.

6. The excess water in an over-saturated concrete necessarily occupies space and thereby bulks-up the mass. By reason of its high surface tension, it forms water globules which, although somewhat affected by the weight of the concrete, are nevertheless distributed throughout the mortar component and are accumulated underneath the particles of the sand and stone aggregates and the reinforcing steel. By evaporation, this excess water ultimately disappears, leaving a considerable volume of water voids and cavities which constitute an extremely important factor in the strength and reliability of the concrete.

7. The critical failure of reinforced concrete depends upon the intensity of the bond existing between the concrete and the steel reinforcement. Concrete containing an excess of water not only develops less surface contact with the steel on account of the resulting increase in the volume of water voids and cavities; but, in addition, the excessive laitance produced by the water tends to accumulate around the reinforcement, thus contributing materially to a decrease in strength. This condition becomes further aggravated by reason of the tendency of the laitance to become less resistant with age.

8. For the various grades of concrete, the minimum ultimate strengths assumed in the modern practice of plain and reinforced-concrete design are not assured by the commonly specified requirements for sand and stone aggregates, and by the present lack of uniformity and of efficiency in field methods and operations.

9. The results obtained show no definite relation between the compressive strengths of 1:3 mortar cubes, and the compressive strengths of the concretes produced from the same sands.

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The output of aluminium from the works at Foyers and Kinlochleven, in Scotland, is said to be well over 10,000 tons per year.

Bill No. 125, entitled, "An Act Providing for the Acquisition by His Majesty of the Capital Stock of the Canadian Northern Railway Co.," follows almost exactly the wording of the resolution upon which the act was based. This resolution was printed on page 109 of the August 9th issue of *The Canadian Engineer*. But few changes have been made in the resolution when put into the form of the bill and these are of a very minor character, chiefly grammatical, and do not change the method of acquiring the stock in any way whatever.

A canvass of the principal shipyards in the United States made on May 1st, showed that 2,250,000 tons of merchant ships were under construction, 52.5 per cent. being built on the Atlantic and Gulf coasts, 33.2 per cent. on the Pacific coast, and 14.3 per cent. on the Great Lakes. The report comprised returns from 96 shipyards. In all, 723 merchant vessels were under construction. Three hundred and nineteen of these vessels, aggregating 1,539,354 gross tons, are freight steamships or motorships, 77 vessels of 365,488 gross tons are tankers, 10 vessels of 55,260 gross tons are passenger and freight steamers, and 118 vessels of 159,663 gross tons are wooden ships, either schooners or auxiliary schooners, while the remainder, or 199 vessels of 128,435 gross tons, are miscellaneous craft, such as barges, lighters, ferryboats, etc.